REMARKS/ARGUMENTS

By this Amendment, claims 1, 6 and 15 are amended and claim 16 is added. Claims 1-2, 5-7, 9 and 15-16 are pending subsequent to the present Amendment.

The Examiner's courtesy in granting an interview to Applicant's representatives on April 28, 2009 is gratefully acknowledged. Applicant's separate record of the substance of the interview is incorporated into the following remarks.

Favorable reconsideration is respectfully requested in view of the foregoing amendments and the following remarks.

The Claims are amended as follows:

Claim 1 is amended to require that the annular core layer has an outer perimeter and a face portion, thereby further clarifying its annular nature. Moreover, the annular wear layer is now required to be for frictional engagement with an adjacent brake disc, and to extend across the face portion of the core layer. Support for this amendment may be found throughout the specification as filed, such as at Figure 2.

Claim 6 is amended to require that the carbide-free C-C wear layer is attached to the face portion of the core layer.

Claim 15 is amended to require that the wear layer is for engagement with an adjacent disc and extends across and is attached to the fence of the core layer.

New Claim 16 is newly introduced.

REJECTION UNDER 35 U.S.C. § 103:

The Examiner rejected claims 1, 2 and 15 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,057,022 (Purdy et al.) in view of U.S. Patent No. 3,897,582 (Olcott) or EP 1260729 (Johnson). The Examiner also rejected claims 1, 2, 5-7, 9 and 15 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,042,935 (Krenkel) or U.S. Publication No. 2003/0057040 (Bauer) or U.S. Patent No. 6,221,475 (Domergue) or U.S. Publication No. 2002/0068164 Al (Martin) in view of GB 2298687 (Fennell) to Purdy et al. or U.S. Patent No. 6,079,525 (Dietrich et al.) and further in view of Olcott and Johnson. These rejections are traversed for the reasons that follow.

The Applicant thanks the Examiner for the opportunity to discuss the earlier rejections. Following these discussions, the Applicant understands that he has addressed all of the previously stated rejections in a satisfactory manner. In particular, the Applicant understands that the Examiner now agrees that none of the previously cited references, including Purdy, describes a brake disc of any kind which has a core layer which is denser than its wear layer.

The Applicant now understands that the Examiner's outstanding rejection is that the subject matter of the application is obvious over Purdy in view of new prior art Nagao (JP 58211031) and Kenji (JP 06074267) that the Examiner stated that she is going to cite (based on a telephone interview). No Information Disclosure Statement is provided citing these references. However, if the Examiner believes that such a Statement is required, it is respectfully requested that the Examiner notify the applicant.

Purdy, as the Applicant has shown, does not describe a brake disc which has separate annular core and wear layers. Rather, Purdy shows a **unitary** brake disc. Moreover, Purdy does not describe a brake discs as having a wear region which is less dense than a core region as those terms are understood by a person of skill in the art. Finally, although Purdy describes the use of densified C-C, there is no discussion of the use of SiC, be it in a wear region or the core of the disc. This point can be extended in that the Examples of Purdy describe discs which are of 0.49 gcm^{-3} in density (see line 40 of column 23) which have a maximum density gain of $1.106gcm^{-3}$ (see Table 3). This results in a density of $1.596gcm^{-3}$, well below that expected for Si-C and below that described, for example, in Claims 2, 6, 9, 15 and 16.

The Applicant submits that the person having ordinary skill in the art would not modify the brake discs described in Purdy, upon the direction of any teaching of Nagao or Kenji, to reach the present invention.

Kenji appears to relate to an automobile brake pad for engagement with a rotating disc, in use, and is concerned with preventing the cracking of that brake pad during use (see paragraphs [0001] and [0007] of the machine translation attached hereto in the Appendix). The skilled person understands that the demands on an automotive brake pad and those on an aircraft heat pack brake disc are incomparable and as such, the skilled person would not look to the teaching of Kenji to modify Purdy.

Furthermore, Kenji does not describe a brake fitting of any kind that is made from the same class of materials as either Purdy or the present invention. Paragraphs [0020] and [0021] describe the manufacturing of the "green compacts" for the brake disc. Essentially, a mixed

powder is pressurised twice to form the dense layer, then more powder is added and the compact is pressed again to form the friction layer.

This green compact is then permanently bound by addition of a hot phenol resin which cools and hardens (see paragraph [0026]).

It is crucial to note that Kenji is **not** describing the manufacture of C-C/SiC brake discs, rather discs made from a phenol resin bound ceramic or metal powder composite.

The skilled person understands that the mechanical properties, heat capacity and frictional characteristics of such composites and C-C/SiC are completely different. It is, therefore, submitted that the skilled person would not see any relevance to C-C brake discs in the teaching of Kenji, and therefore would not apply its teaching to Purdy.

Moreover, Kenji teaches the skilled person to manufacture the dense and less dense layers of the brake disc from **the same material**, thus ensuring that there is a minimised difference in coefficient of friction between them.

The present invention in contrast with both Kenji and Purdy requires that a different material, SiC infiltrated C-C, is used to make the core of the disc as compared to the C-C which comprises the wear layers. These two materials have very different properties which go far beyond the difference in density, as the Applicant outlines on pages 2 and 3 of the application in suit. In particular, the friction and wear properties of SiC and C-C are different, an arrangement which the teaching of Kenji specifically teaches away from (see paragraph 0008 of the machine translation).

It is therefore submitted that the person of ordinary skill in the art would not combine the teachings of Purdy and Kenji and, even if he did, he would not reach the invention described in the present application.

Again Nagao appears to relate to a brake pad for all in a calliper set in an automobile. It describes a semi-metallic laminate brake pad which has been modified to prevent rust and delamination.

The Applicant submits, once again, that this teaching is incompatible with the teaching of Purdy in the eyes of the person having ordinary skill in the art.

The pad materials of automobile brakes are **not** suitable as brake discs in aircraft. The person of ordinary skill in the art knows that.

Certainly, the person of ordinary skill in the art understands, that the C-C discs of Purdy will not rust, and moreover, Purdy's discs are **unitary** rather than laminate, so would not suffer any delamination. There would, therefore, appear to be no reason, and in fact a positive disincentive, for the skilled person to combine the teaching of Nagao with that of Purdy.

It appears that the Examiner considers Nagao relevant because of the presence of the insulating layer (2) which may have a raised density. However, the teaching that this layer (2) of the brake pad of Nagao should be insulating means that even if stretching credulity to its limit, the skilled person were to combine Nagao with Purdy, the present invention would not be reached.

The SiC infiltrated core layer as provided by the present invention acts as a **heat sink**, as is understood by the skilled person. This is the opposite of the insulator described by Nagao.

Providing an insulating core layer in a disc of Purdy would likely result in the friction faces overheating, thereby causing oxidation, damage and ensuring that performance would consequently reduce.

It is, therefore, submitted that all Claims are inventive over Purdy in view of Kenji or Nagao and that the application should accordingly be allowed.

The Applicant therefore submits that all of the Examiner's rejections have been overcome and that the application has been placed in a condition for allowance.

For at least the reasons set forth above, it is respectfully submitted that the above-identified application is in condition for allowance. Favorable reconsideration and prompt allowance of the claims are respectfully requested.

Should the Examiner believe that anything further is desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicant's undersigned attorney at the telephone number listed below.

Respectfully submitted,

CAESAR, RIVISE, BERNSTEIN,
COHEN & POKOTILOW, LTD.

June 25, 2009

By: _____

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Please charge or credit our Account No. 03-0075 as necessary to effect entry and/or ensure consideration of this submission.

Enclosure: Appendix - a machine translation of Kenji (JP 06074267)

APPENDIX

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the disc brake pad for vehicles, and relates to the art of preventing a crack from occurring especially in the friction material of that.

[0002]

[Description of the Prior Art]The above-mentioned disc brake pad has the friction material and back plate which are generally forced on the disk rotor rotated with a wheel, and control rotation of a wheel, and a friction material adheres to a back plate and it is constituted.

[0003]These people thought out the following previously so that there may be a request of liking to prevent certainly, about a crack occurring in the friction material of that and it may fill this request from the former in this disc brake pad. It makes a friction material the laminated structure containing the 1st layer of a side of a disk rotor, and the 2nd layer of a side of a back plate as indicated to JP,58-45437,U, And while changing material between the 1st layer and the 2nd layer, it is the disc brake pad which used

material of the 2nd layer as the material which excelled the material of the 1st layer in crack resistance.

[0004]

[Problem(s) to be Solved by the Invention]However, it became clear that there were the following problems in this conventional disc brake pad.

[0005]If wear of a friction material progresses along with use of a disk brake, the portion which ****s to a disk rotor among friction materials will shift to the 2nd layer from the 1st layer. In this conventional disc brake pad, since material is changed between the 1st layer and the 2nd layer, usually the coefficients of friction of a friction material differ comparatively greatly between the 1st layer and the 2nd layer. Therefore, when a frictional part with a disk rotor shifts to the 2nd layer from the 1st layer in a friction material, the coefficient of friction of a friction material changes comparatively a lot. On the other hand, as for the speed of advance of wear of a friction material, it is common to differ mutually among two or more wheels. Therefore, when wear of a friction material advances, the coefficients of friction of a friction material differ mutually between each wheel, and there is a problem that there is a possibility that a little big braking effort difference may occur between each wheel.

[0006]It makes as a technical problem that it raises the crack resistance of a friction material in view of such a situation, this invention suppressing as

small as possible change of the coefficient of friction accompanying advance of wear of a friction material.

[0007]

[Means for Solving the Problem]In a disc brake pad which a friction material which this invention is forced on a disk rotor rotated with a wheel, and controls rotation of a wheel in order to solve this technical problem adheres to a back plate, and changes, While constituting the whole friction material from same material, it was made high rather than were able to set density of the friction material to the back-plate side at the disk rotor side.

[0008]

[Function]When a high density part and a low density part are formed using the same material, i.e., the same single material, or the composite material of the same presentation, it is common that the high density part excels a low density part in crack resistance. It is because the strong thing is more common than a direction [in / in the associative strength between each material particles / a high density part] can set to a low density part. Although the coefficient of friction of a high density part and the coefficient of friction of a low density part differ a little in this case, Since being mostly decided with a composition material is common in a disc brake pad as for the coefficient of friction, the difference of the coefficient of friction of a high density part, and the coefficient of friction of a low density part, Compared with the case where crack resistance is raised selectively, small one is common by changing material in said conventional disc brake pad.

[0009]on the other hand -- the density of a friction material -- overall -- an ordinary lay -- crack resistance improves from the case where the direction in the case of making it high makes it high selectively. However, when densification of the whole friction material is carried out, the damping characteristic of a friction material falls greatly, it becomes easy to generate the so-called squeal of a brake, and the tendency for fade-proof nature etc. to get worse is also still stronger. Therefore, it is desirable for the necessity of raising especially crack resistance to make density high only within a high portion, i.e., the portion which a crack tends to generate.

[0010]In the disc brake pad applied to this invention based on the above knowledge, It is made high, and while the whole friction material comprises same material, thereby, crack resistance is raised by the back-plate side which is a portion which especially a crack tends to generate rather than being able to set to the disk rotor side, rather than the density of the friction material can set to the back-plate side at the disk rotor side.

[0011]

[Effect of the Invention]Thus, according to this invention, since the whole friction material comprises same material, the effect that crack resistance is raised is acquired, change of the coefficient of friction of the friction material accompanying advance of wear of a friction material being suppressed small.

[0012]Generating the crack of a friction material from the side of that, and generating from the near position of a back plate among the side moreover is checked experimentally. Therefore, if based on such a fact, in the tabular whole portion which adjoins a back plate among friction materials, density is not made high, but it is possible to make density high only in the periphery of the tabular portion. However, if a crack advances and a high density part is penetrated in this case, it is difficult for a crack to advance easily and to prevent a crack generation in the long run after that.
[0013]On the other hand, according to this invention, density is made high rather than being able to set into other portions in the tabular whole portion which adjoins a back plate among friction materials. Therefore, even if a crack occurs on the side of a friction material, it will be controlled certainly that it advances even in the center section, and the effect that the crack resistance of a friction material improves in the long run is also acquired.

[0014]

[Example]Hereafter, some examples of this invention are described in detail based on a drawing.

[0015]The friction material 10 adheres to the back plate 12, and the disc brake pad which is one example of this invention is constituted, as shown in drawing 1.

[0016]The friction material 10 is made into the two-layer structure which

comprises the density part 20 and the high-density part 22 which is usually the 2nd layer of a side of the back plate 12 which are the 1st layer of a side of the disk rotor which is not illustrated. These usual density part 20 and the high-density part 22 comprise a composite material of the same presentation. The presentation is expressed below in a table.

[0017]

[Table 1]

[0018]Although a part of high-density part 22 is made to penetrate the back plate 12 in drawing 1, this is for raising fixing strength with the back plate 12 using anchoring.

[0019]The following two can be considered to the process of the friction material 10. These each process is explained roughly first.

[0020]The 1st process pressurizes material twice under the almost same pressure (compression), fabricate the green compact which will be the high-density part 22 by previous application of pressure in the future, and by next application of pressure. By pressurizing in one the mixed powder which will usually be the density part 20 its green compact and in the future, adhesion with the density part 20 is usually simultaneously performed [densification / of the high-density part 22] with shaping of the density part 20, and the high-density part 22. Densification is realized by pressurizing twice the mixed powder which will be the high-density part 22 in the future.

[0021]On the other hand, the 2nd process pressurizes material 3 times, usually fabricates the density part 20 separately with the high-density part 22 by two previous application of pressure, respectively, and pastes both up by one next application of pressure. It is made high, and the high-density part 22 is fabricated by application of pressure under high voltage, and the density part 20 is usually separately fabricated by application of pressure under low pressure, respectively rather than being able to set the pressure in the case of two previous application of pressure on another side in one side.

[0022]Next, each process is explained concretely.

[0023]In the 1st process, it is mixed using the V type blender which the material (powder) which has first the combination presentation shown in

said table does not illustrate. A part of this mixed powder is made into the high-density parts 22, and the remainder is usually made into the density parts 20. Then, as shown in drawing 2, the mixed powder for ** high-density part 22 is thrown in in the preforming metallic mold 30. then, ** -- the mixed powder is pressurized for about 30 seconds under the pressure of about 600 kg/cm^2. Thereby, the plate-like green compact which will be the high-density part 22 in the future is fabricated. then, ** -- phenol resin as a binder is sprinkled by the surface of the green compact. The reason for having used the binder is mentioned later.

[0024]Next, among ** mixed powder, the remaining things, i.e., the mixed powder usually for density part 20, are further supplied in the preforming metallic mold 30, and it is laminated by the surface of said green compact. then, ** -- the mixed powder thrown in additionally is pressurized for about 30 seconds under the pressure of about 600 kg/cm^2 together with the green compact which exists previously. Shaping of the density part 20 and both adhesion are usually simultaneously performed with shaping of the high-density part 22 by this, By being pressurized twice, density is usually made higher than the density part 20, material is elaborated, the degree of coupling between material particles is raised by the high-density part 22, and crack resistance is raised. In this example, the thickness of the high-density part 22 shall be 1.5 mm, and, on the other hand, the thickness of the density part 20 is usually 8.5 mm.

[0025]Then, in an ordinary disc brake pad, thermoforming (accompanied by

adhesion with the friction material 10 and the back plate 12), heat treatment, paint of the back plate 12, and polish of the friction material 10 are performed in order similarly.

[0026]It is supplied in the thermoforming die which the high-density part 22 and the green compact by which the density part 20 was usually fabricated in one do not specifically illustrate with "thermoforming" here, The green compact is that hot forming is carried out for about 10 minutes under the pressure of about 400 kg/cm^2, and the temperature of about 160 ** in the state where it was stuck with the back plate 12. Thereby, while phenol resin in a green compact flows and hardens, a green compact adheres to the back plate 12 by adhesion as the friction material 10, and a disc brake pad is assembled. Specifically, "heat treatment" is that the disc brake pad is heat-treated under about 250 ** temperature for about 3 hours.

[0027]Next, the 2nd process is explained concretely.

[0028]As mixing of material is similarly performed in the 1st process, then this process is first shown in drawing 3, ** the thing for high-density part 22 is supplied in the preforming metallic mold 30 among the mixed powder -- after that and ** -- the mixed powder is pressurized for about 30 seconds under the pressure of about 600 kg/cm^2. Thereby, the high-density part 22 is fabricated.

[0029]moreover -- the thing for density part 20 is usually supplied in

another preforming metallic mold 30 among ** mixed powder -- then, ** -- the mixed powder is pressurized for about 30 seconds under the pressure of about 100 kg/cm^2. It is pressurized under a pressure lower than the case where the high-density part 20 is fabricated, and, thereby, the density part 20 is usually fabricated.

[0030]As mentioned above The high-density part 22 and after the density part 20 was usually fabricated separately, respectively, ** the inside of the high-density part 22 and the preforming metallic mold 30 with the density part 20 usually same in piles -- and it is made to usually intervene phenol resin as a binder between the density parts 20 with the high-density part 22, and is supplied, then is pressurized for about 30 seconds under the pressure of **about 600 kg/cm^2. Thereby, adhesion with the density part 20 is usually performed with the high-density part 22.

[0031]Then, in the 1st process, thermoforming, heat treatment, paint, and polish are performed in order similarly.

[0032]These people did the examination of [an ordinary disc brake pad], the performance of a disc brake pad, i.e., the crack resistance, which are constituted as mentioned above. The contents of the examination are as follows.

[0033]1. disc brake pad ** manufactured by the disc brake pad ** 2nd process manufactured by the specimen ** 1st process -- an ordinary disc

brake pad -- with "an ordinary disc brake pad" here. The whole friction material is equalized by the usual density, and as shown in drawing 4, said mixed powder is thrown in in the preforming metallic mold 30 all at once, and it is pressurized for about 30 seconds under the pressure of about 600 kg/cm^2, and it is fabricated.

[0034]2. Examine using the full-size brake dynamometer which attaches the brake of test equipment thing.

[0035]3. Make for temperature to be 300 ** at the time of the braking start of a test condition disk rotor, and to carry out quick braking of the vehicle speed to 50 km/h under the deceleration of 0.6G from 150 km/h into one cycle, and repeat it 2000 times.

[0036]It is based on the following reasons that temperature was 300 ** in advance of each cycle at the time of the braking start of a disk rotor. not only the load that acts on a friction material by research of these people repeatedly but the repetition heat stress by degradation of the organic matter in the friction material by an elevated-temperature history, and the thermal expansion and contraction in the friction material side and the unevenness of the heat stress -- cause ******** of a crack generation -- things have become clear. It is because organic matter degradation tended to be reproduced in view of this fact by making temperature into an elevated temperature at the time of the braking start of a disk rotor, generating of the repetition heat stress by braking tended to be reproduced by making

temperature regularity each time at the time of a braking start and it was going to reproduce the generation state of the crack synthetically as faithfully as possible.

[0037]Although the crack occurred in each specimen by the above examination, the length of the crack was measured as follows that crack resistant strength should be evaluated as length of a crack.

[0038]That is, first, as shown in drawing 5, one of four angles of each disc brake pad is cut to rectangular shape, and let a field parallel to a disk rotor hand of cut be an observed face among two cutting planes of the piece of a rectangle. An example of an observed face is shown in drawing 6. And the observed face was observed using the electron microscope, and the length of the crack generated there was measured.

[0039]The measurement result is as follows. ** **********3mm** manufactured by the **********3 mm** 2nd process manufactured by the 1st process -- common -- express this measurement result with a graph to drawing 7 **********15 mm.

[0040]Also in which disc brake pad, it was also checked from the back plate among friction materials that the crack has occurred in the position which is separated from about 0.1-1.0 mm.

[0041]The disc brake pad which is this example has crack length shorter than an ordinary disc brake pad, and its crack resistance is improving so that clearly from the above test result.

[0042]In order for each to usually paste up the density part 20 and the high-density part 22 in two processes in this example, the binder was used, but it is for this raising the adhesive strength. Usually, phenol resin is blended with the density part 20 and the high-density part 22 as a binder. This phenol resin flows with heat and a pressure, and is hardened soon. Therefore, it is possible to paste up without making phenol resin the density part 20 and the high-density part 22 usually intervene because of the mobility. however -- the friction material 10 is non asbestos material which does not use asbestos, and there are many granular material and whisker shape things as compared with asbestos material -- presentation combination ---like -- porous one, since it is that it is ****, Even if heat and a pressure are added and each phenol resin in the density part 20 and the high-density part 22 usually comes to show mobility, Usually, many also flow toward each inside of the density part 20 and the high-density part 22, and the tendency which usually flows into another side from one side of the density part 20 and the high-density part 22, and connects both becomes weak. Therefore, in [when the density part 20 and the high-density part 22 are usually pasted up without making phenol resin intervene, there is a possibility that sufficient adhesive strength may not be obtained, and] this example, A binder is used and phenol resin is used as a binder in

consideration of conformity with the phenol resin which moreover usually exists in the density part 20 and the high-density part 22 from the beginning. However, it is not necessary to necessarily use a binder. For example, since the debt between resin will become strong if the interface of the density part 20 and the high-density part 22 is usually fluffed with a knife etc., it is not necessary to use phenol resin as a binder.

[0043]In this example, densification only of the portion which a crack especially tends to generate on the assumption that the friction material 10 whole comprises material of a common presentation is carried out selectively, and crack resistance is raised so that clearly from the above explanation. Therefore, the effect that the crack resistance of the friction material 10, i.e., endurance, improves is acquired, without affecting the basic performance of a brake, change of the coefficient of friction between the disk rotor and the friction material 10 accompanying advance of wear of the friction material 10 being suppressed small.

[0044]In this example, density of the friction material 10 whole is not uniformly made high, Densification is carried out only in the portion effective in especially crack prevention, i.e., the portion which adjoined the back plate 12, and the decrease amount to the ordinary friction material of the damping characteristic of the friction material 10 is stopped as small as possible. Therefore, the effect that it is avoided that originate in densification and squeal-proof nature falls is also acquired.

[0045]Since density is made high rather than being able to set into other portions in this example in the tabular whole portion which adjoins the back plate 12 among the friction materials 10, Even if a crack occurs on the side of the friction material 10, it will be controlled certainly that it advances even in the center section, and the effect that the crack resistance of the friction material 10 improves in the long run is also acquired. [0046]As mentioned above, although one example of this invention was described in detail based on the drawing, this invention can be carried out in other modes.

[0047]For example, as shown in drawing 8 and drawing 9, it is possible to make it thicker than a center section in the periphery of the friction materials 60 and 62 at least among the high-density parts 50 and 52, and to raise further the crack resistance of the periphery of the friction materials 60 and 62 by this. And it is made to expose to the friction surface of the friction material 60, or the heavy-gage part of the high-density parts 50 and 52 can be made not to expose like the high-density part 52 shown in drawing 9 like the high-density part 50 shown in drawing 8. In the case of the former, although a part of high-density part 50 will **** to a disk rotor from the initial state of the friction material 60, there is no possibility that the area may usually have an adverse effect on the basic characteristic of a brake since it is quite small compared with the density part 70.

[0048]Although the friction material was made the two-layer structure by

each in the example described above, the interlayer who has both middle density may be provided between the 1st layer of a side of a disk rotor, and the 2nd layer of a side of a back plate, for example.

[0049]It is possible to carry out this invention in the mode which performed various modification and improvement based on a person's skilled in the art knowledge, without deviating from a claim other than these.

[Translation done.]